The NOAA-ETL Ground-based Remote Icing Detection System

"GRIDS"

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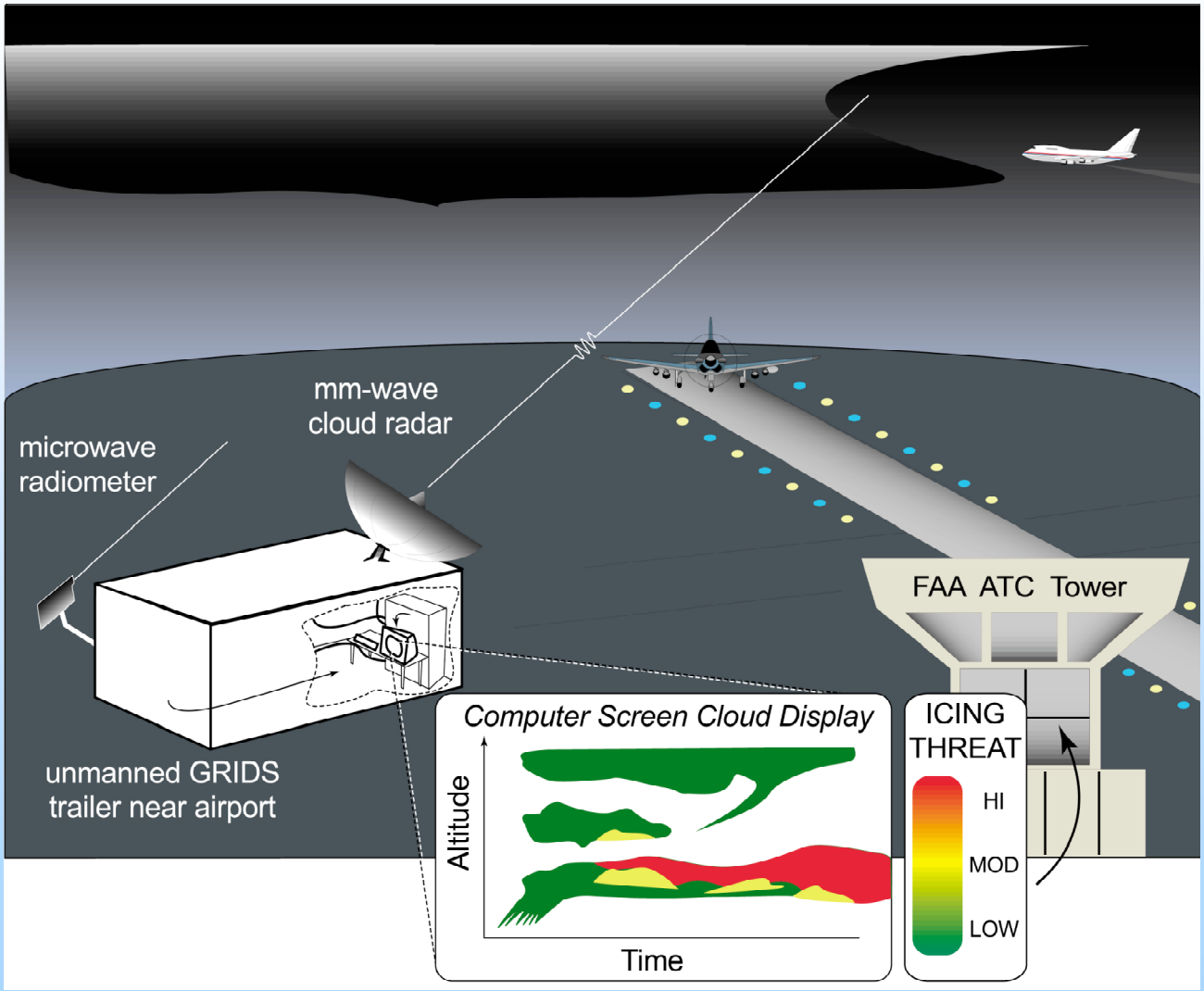
NOAA-ETL

Acknowledgements:

- The GRIDS team, past, present & future
- FAA AWRP Sponsorship
- IFI-PDT led by Marcia Politovich

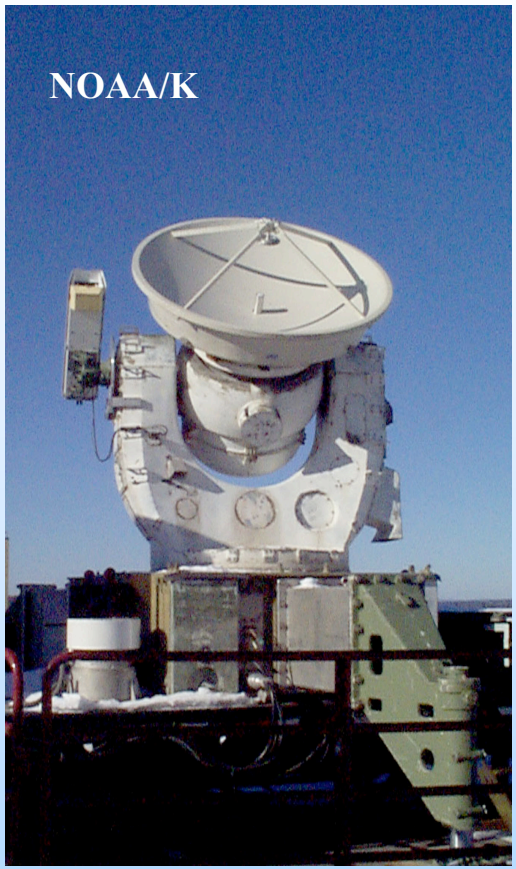
The NOAA-ETL Ground-based Remote Icing Detection System



The GRIDS Design

- **System**
  - Autonomous -- only needs power & internet*
  - Robust -- 24/7/365 unattended operations
- **Radar**
  - High Sensitivity (-60 dBZ @ 10 km AGL/~15km range):
    increase dwell, pulse length; 3 m antenna; hi power TWTA
  - Polarized (nearly circular) [Depolarization Ratio
  - Fixed Beam 40° elevation
    - *Vertical Beam w/Doppler Spectra optional*
- **Microwave Radiometer**
  - 2 Channels (23.8 & 31.6 GHz; *90.0 GHz optional* *)
  - Measures Column Liquid & Vapor
- **Temperature Profile**
  - RUC Model - Hourly Ingest
  - T_{liq} mean (*from 90GHz option* *)

Based on proven technologies…

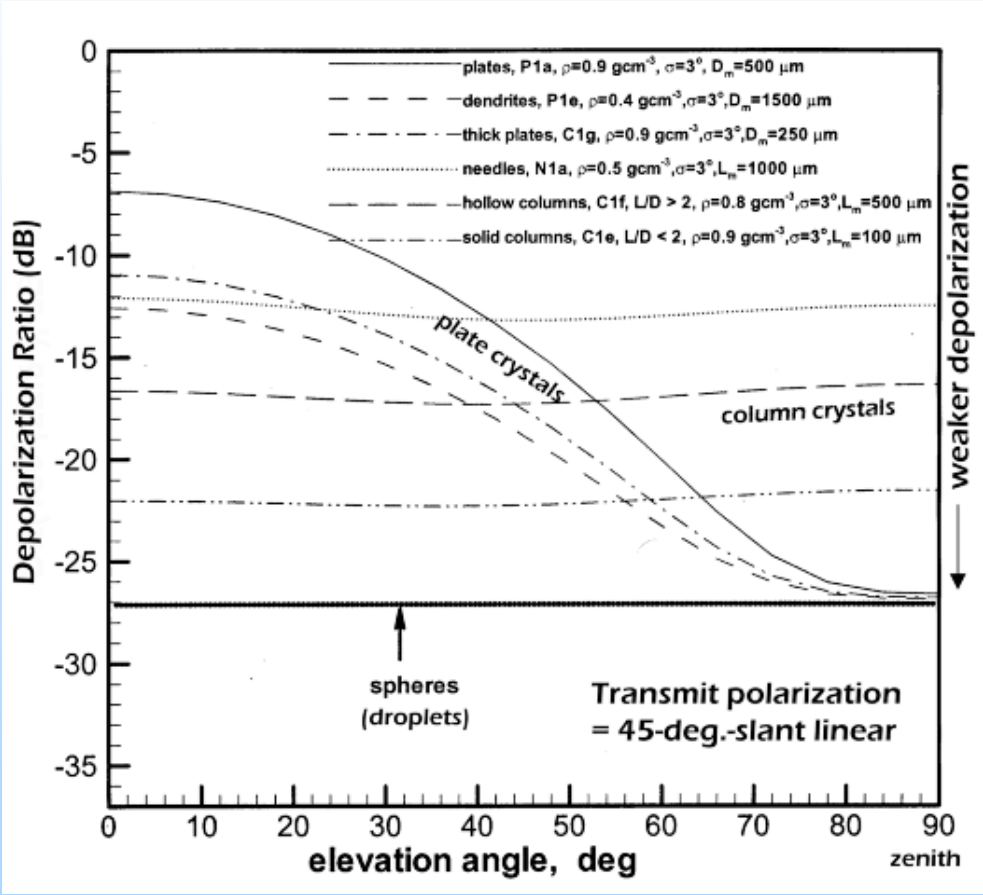


Discriminating Ice & Liquid: DR

Slant-45 Quasi-Linear Polarization

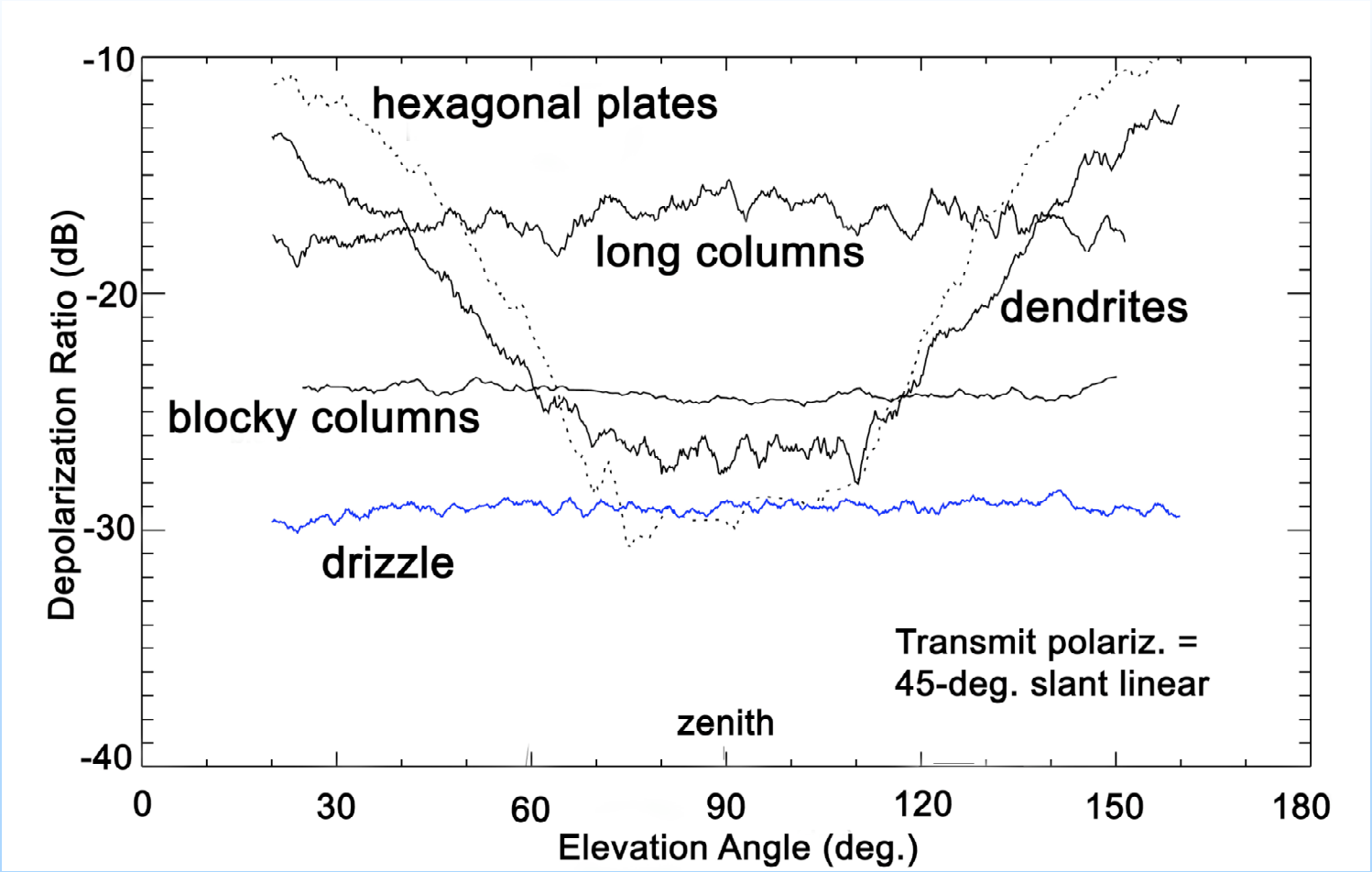
THEORY

- Minimum crystal flutter sensitivity.
- Very good separation by shape.
- Drizzle vs. Ice differ though wide elevation arc.
- Deterministic drizzle I.D. above cross-talk.
- Sensitive to lower reflectivity clouds.

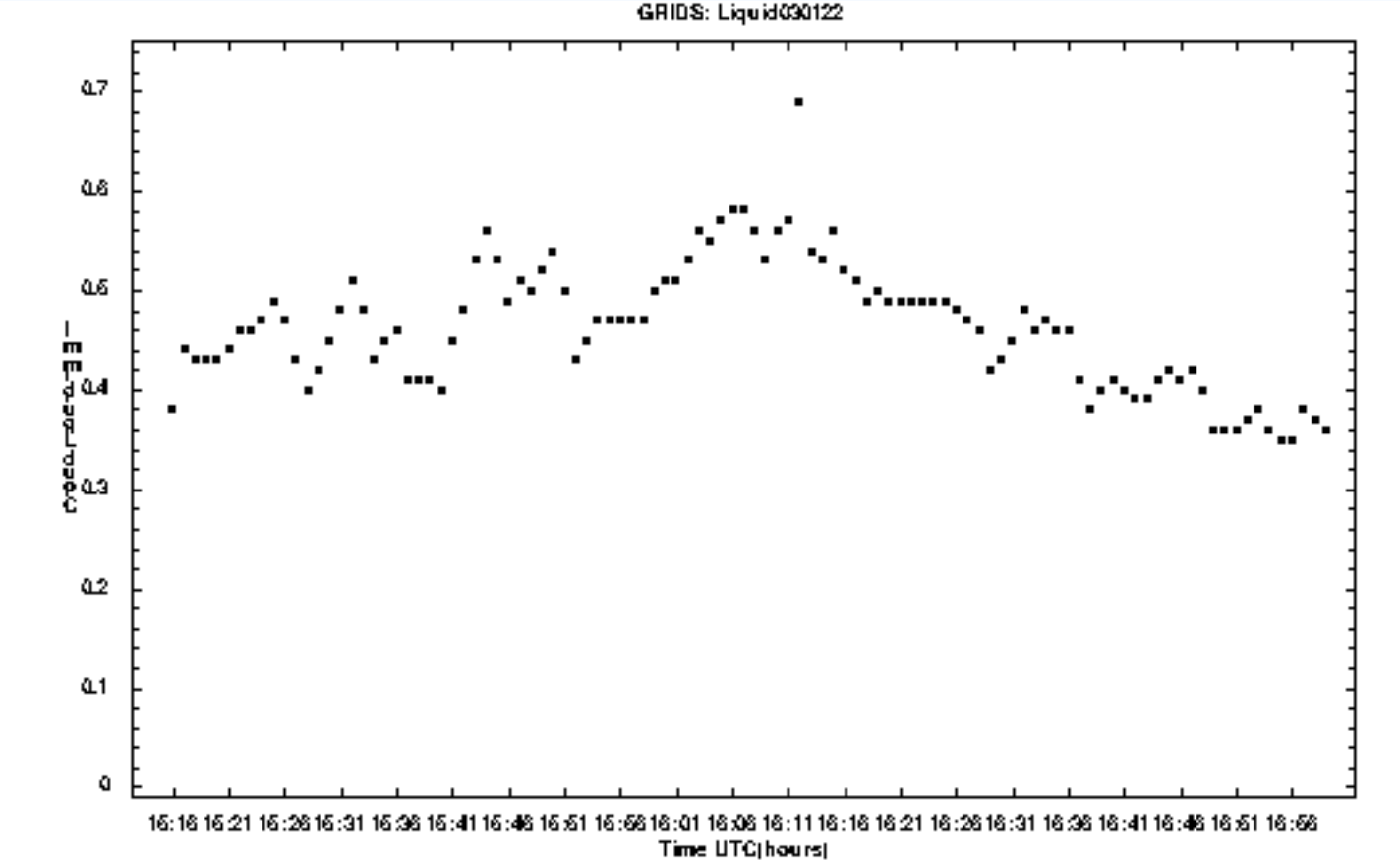


DR Measurements of Irregular Ice Crystals and Supercooled Drizzle

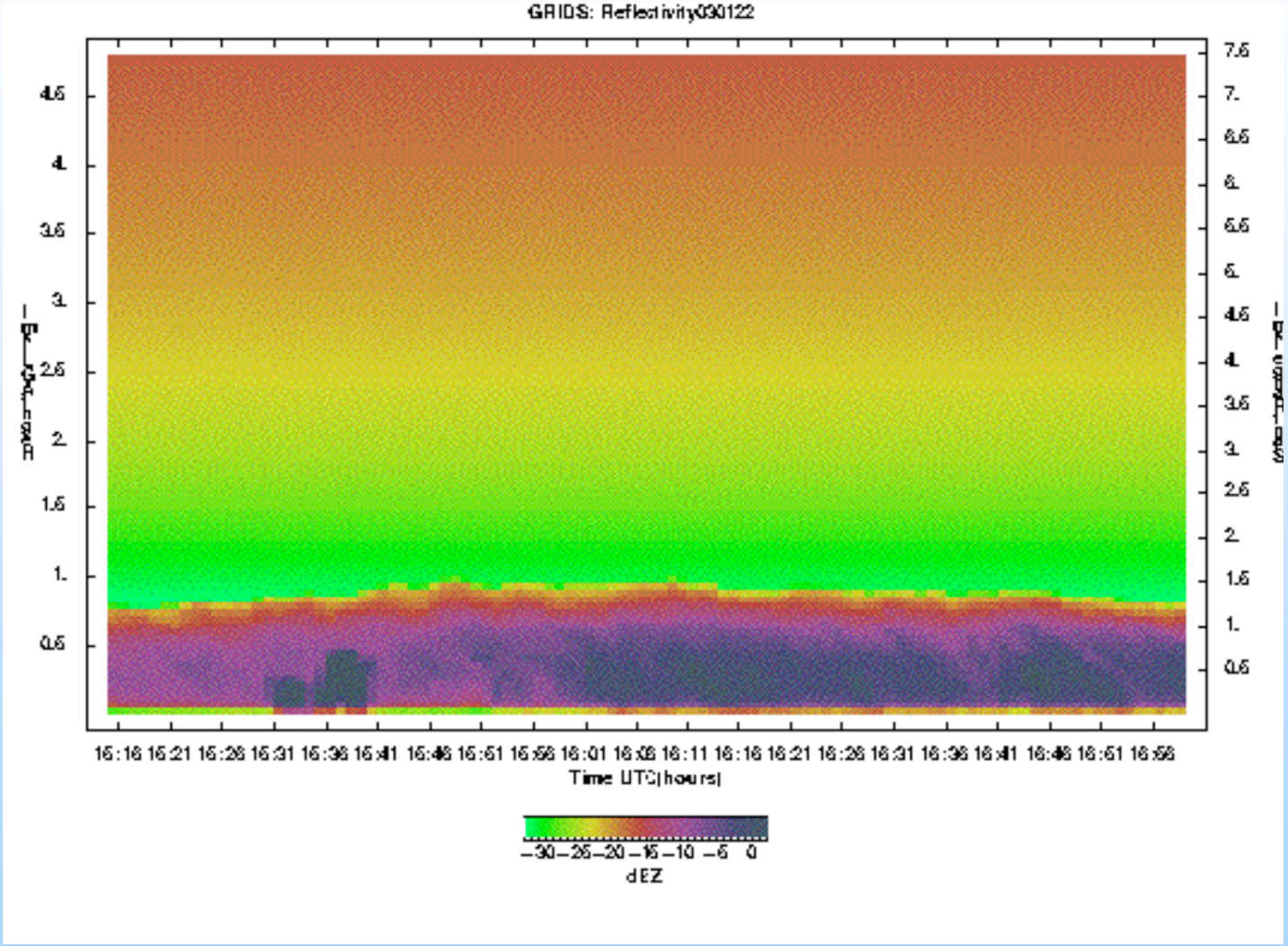
Verified w/in-situ data!



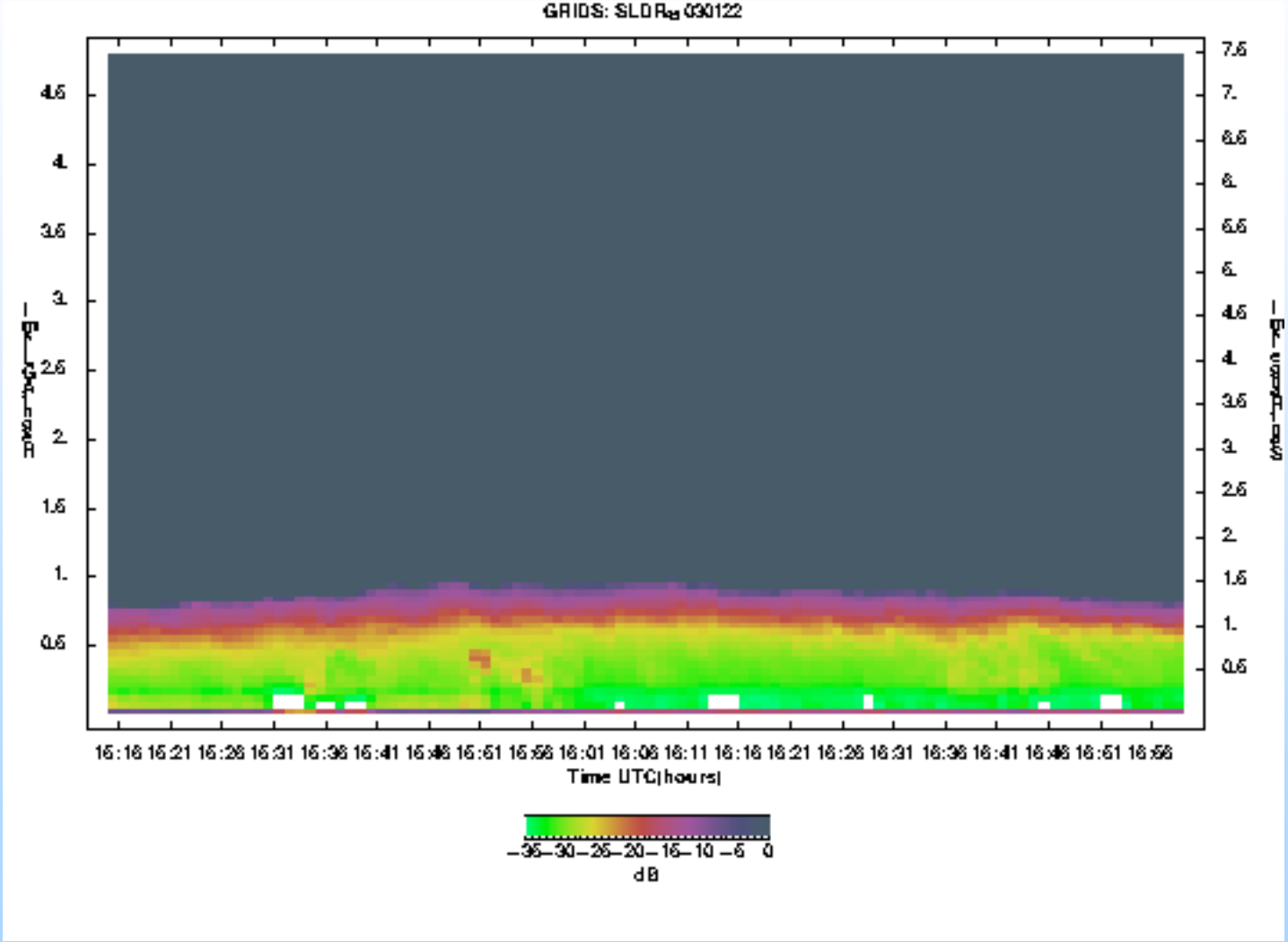
AIRS-1.5 Liquid



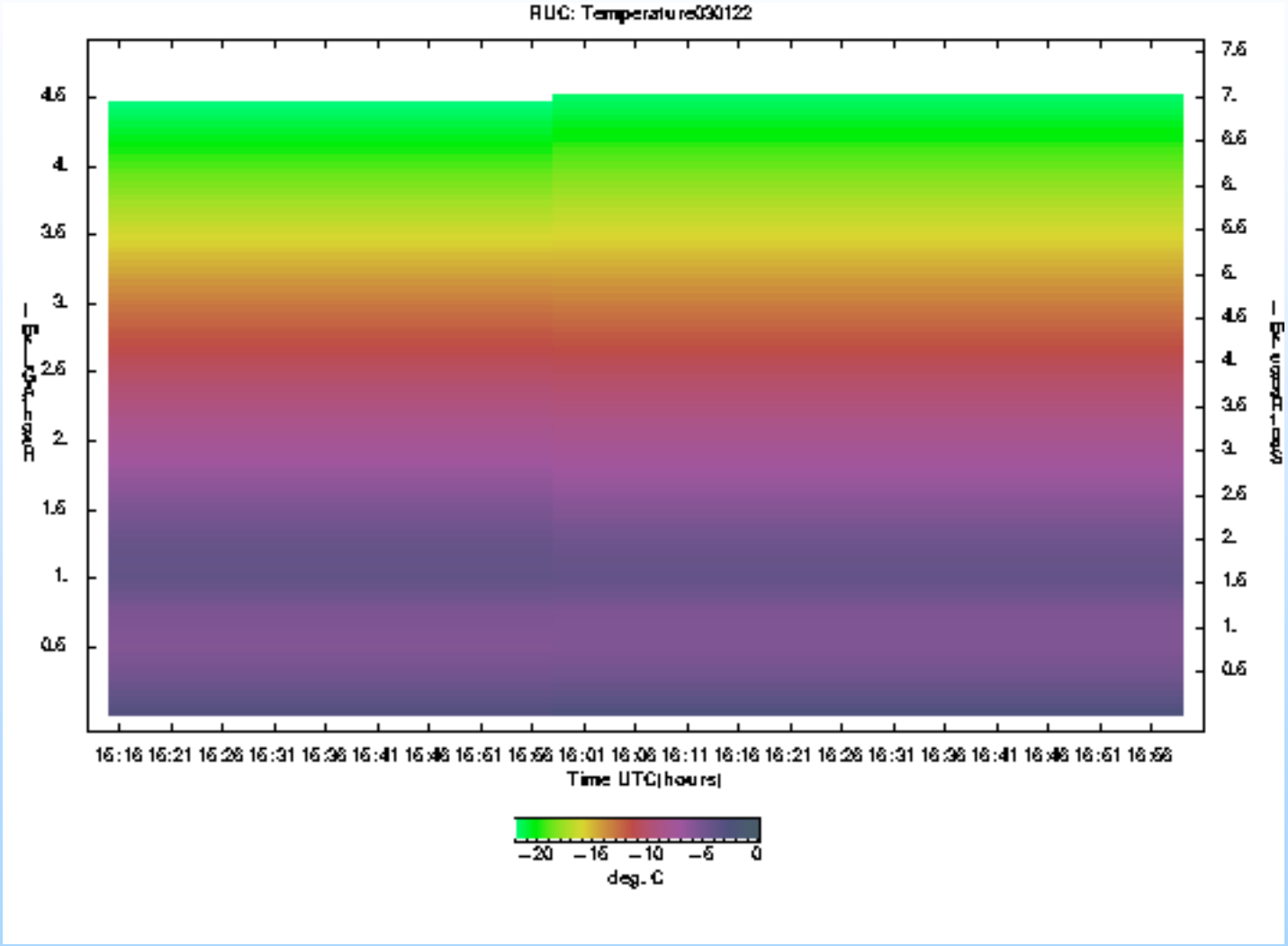
AIRS-1.5
Radar Reflectivity



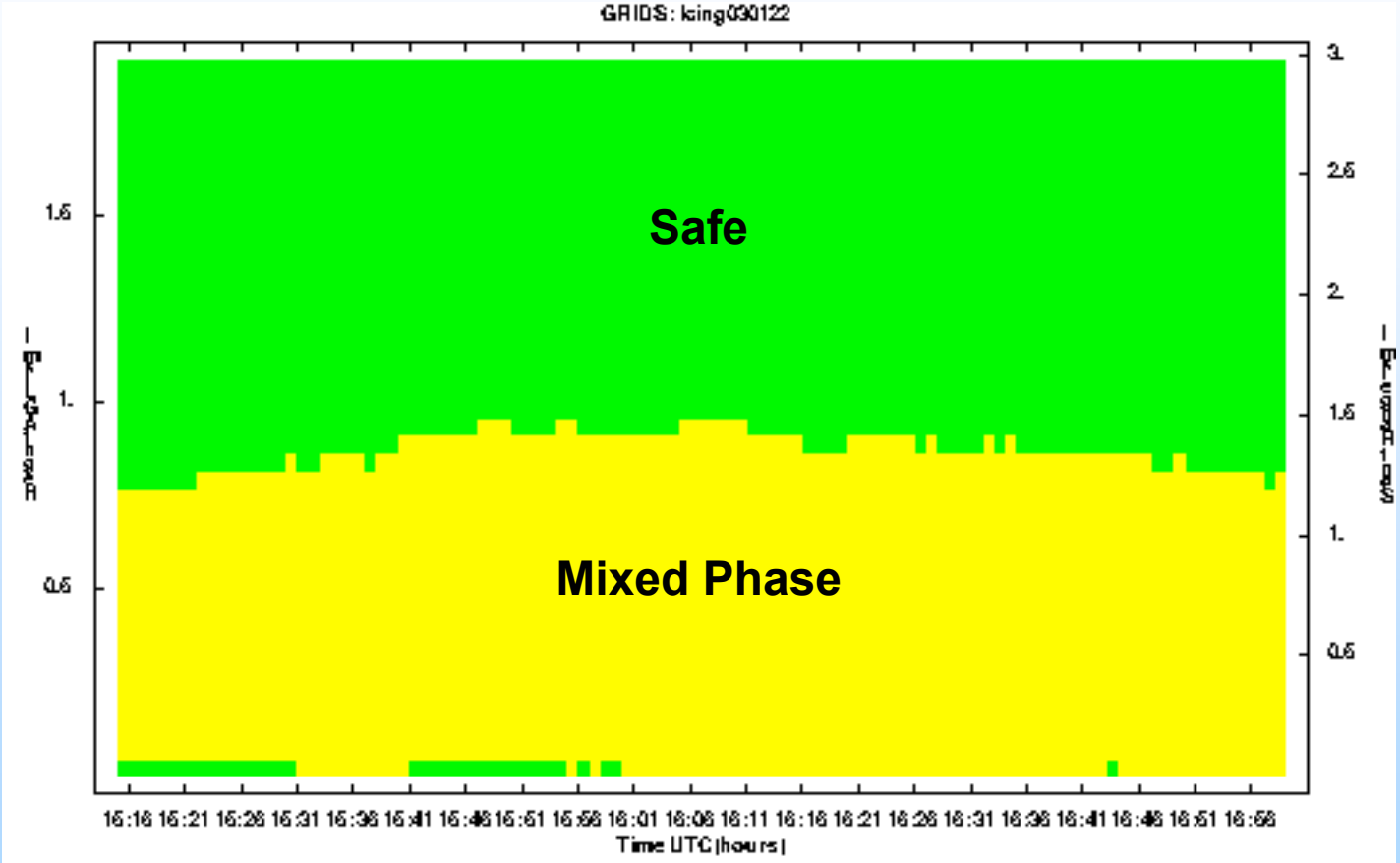
AIRS-1.5
Depolarization Ratio



AIRS-1.5 Temperature



AIRS-1.5
Icing Hazard



Implementation Plan

- **Design "Target" GRIDS: Completed Sept. '01**
  - Full Sensitivity
  - Unattended 24/7/365 Operations
  - Real-Time Graphical Output (2 min update)
  - Auto Calibration and Health
  - Zenith/Doppler Spectra Option
- **Build "Upgradable" GRIDS: Ongoing (Fall '02)**
  - Fast-Track Effort
  - Use Target Blueprint
  - Borrow Components
  - Less Sensitive; Semi-Autonomous
  - Goal - Participate in AIRS -II (Nov '03) & WISP 3/4 (Wi/Sp '04)
- **Evolve to "Target" GRIDS: FY06 - FY07**
  - Timeline is Partner-Dependent (FAA; NWS)
  - Ends with Extended Demo/Assessment @ a Great Lakes Airport

Other Applications

- Aviation Weather:
  - Multiple ceilings and visibility
  - In-cloud turbulence
  - Verification/parameterization of/in icing models (NWS).
  - NEXRAD verfication and algorithm development (NWS).
- Other Applications:
  - Detection of freezing drizzle (highway safety)
  - Detection of rain in shallow, near-surface clouds (NEXRAD)
  - Verification for numerical forecast models
  - Cloud fields for assimilation in numerical weather models.
  - Climate/cloud process studies: vertical structure of cloud properties, esp. partitioning of water substance and radiant energy.
  - Data to verify & calibrate satellite cloud observations to clarify the impact of the vertical dimension on passive cloud retrievals.

New Developments & Upgrades Part I

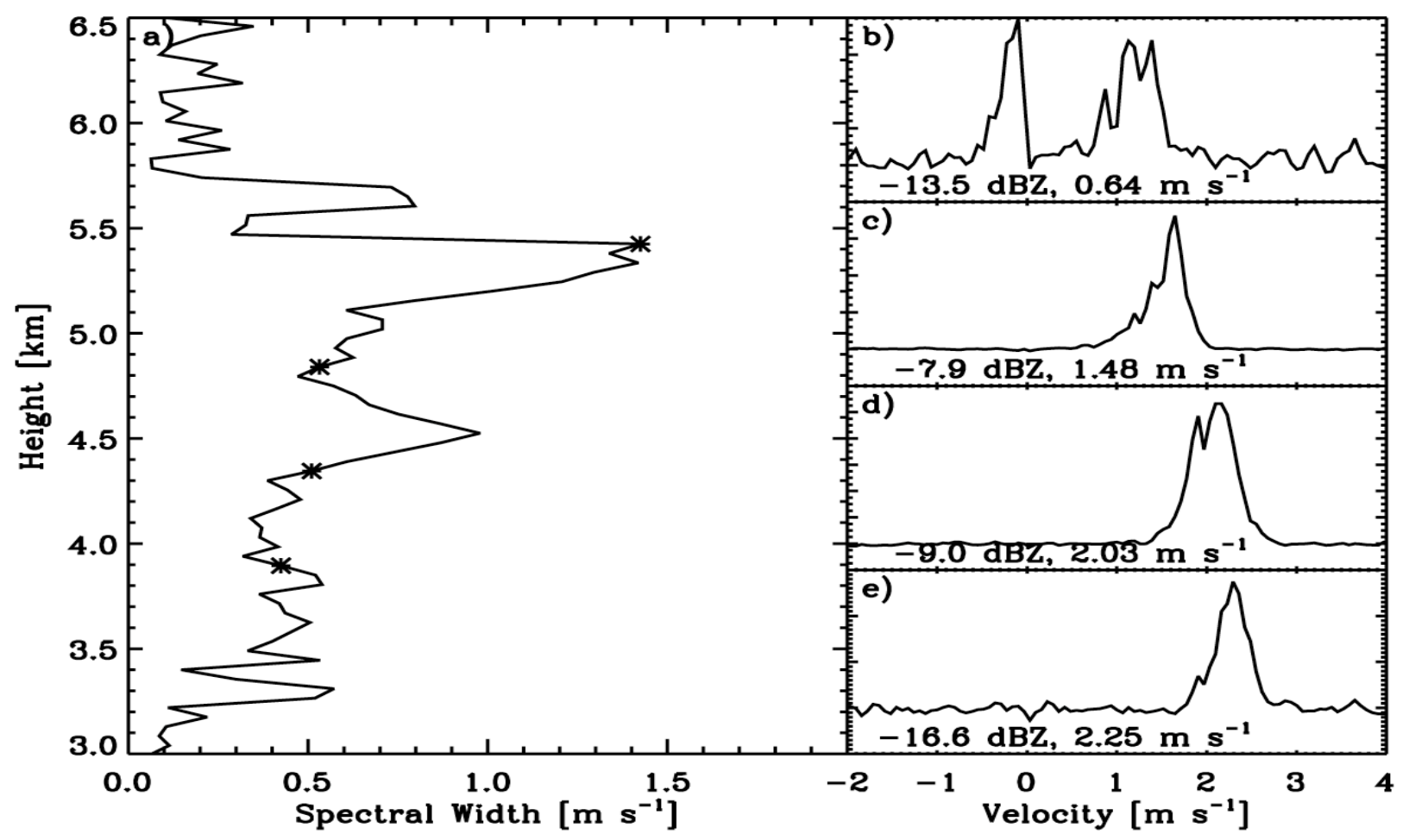
- RADS [GRADS
  i. GRADS software is built from existing RADS software, which has been in use for eight years in ground-based scanning and airborne systems;
  ii. offers high-resolution real-time displays of up to 32 meteorological parameters;
  iii. modular software design allows for easy addition of new capabilities;

- ["DIGI-GRADS"
  i. new Linux-based PC system is low cost;
  ii. digital receiver enhances dynamic range;
  iii. signal processing done on host Pentium (no DSP board required) is portable and scalable;
  iv. permits us to upgrade to spectral processing

New Developments & Upgrades Part II

- Bayesian retrieval algorithms
  - McFarlane & Evans
  - In collaboration with NCAR/IFIPDT
  - Relates observable moments to physically desirable moments.
- Cloud liquid temperature from 3-channel radiometer (90 GHz)
- Doppler Spectra; from optional vertical mode

New Developments & Upgrades
Part II - Döppler Spectra



New Developments & Upgrades Part III

- New method to measure depolarization ratio
  - Sergey Matrosov
  - Less sensitivity required in co-polar channel.

- Airborne radar and radiometry:
  - Collaboration with Steve Sekelsky/UMass
  - Scanning, W-band, polarimetric Doppler radar
  - PSR multifrequency radiometers.

New Developments & Upgrades
Part III - PSR Scanhead